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STATISTICAL ANALYSIS MODEL OF COLLECTED DRAGLINE TIME CYCLE DATA

J.K. Szymanski, W. Borysuk, C. Williams

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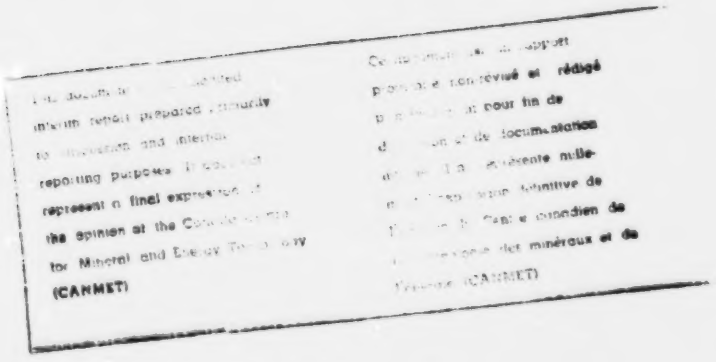

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STATISTICAL ANALYSIS MODEL OF COLLECTED DRAGLINE TIME CYCLE DATA

by

J.K Szymanski*, W. Borysuk** and C. Williams***

ABSTRACT

A cooperative effort in 1988 produced a SLAM II simulation model that predicts operation performance of the dragline at Obed Mountain Coal mine. In order to model this stochastic system, the selection and estimation of probability distributions for a dragline cycle components is of paramount importance. The available sample data was analyzed and the results showed that the simple Weibull or simple Lognormal distributions were fitted equally well.

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MODELE D'ANALYSE STATISTIQUE DES DONNEES RECUEILLIES SUR LE CYCLE D'UTILISATION D'UNE DRAGLINE

par

J.K. Szymanski*, W. Borysuk** et C. Williams***

RESUME

Un effort de collaboration en 1988 a produit un modèle de simulation SLAM II qui prédit le rendement de la dragline à la mine de charbon d'Obed Mountain. Pour modéliser ce système stochastique, il est essentiel de choisir et d'estimer des distributions de probabilité pour les composantes du cycle de la dragline. Les données d'échantillonnage disponibles ont montré que les simples distributions de Weibull ou lognormale convenaient également bien.

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INTRODUCTION

A computer model had been developed to simulate the operation of the dragline in Obed Mountain Coal mine. In this model,a stochastic simulation is used to reflect the random variation in duration of all components of the time cycle. To model these simulation inputs, during the period of January 8 - February 29, 1988, data was collected from an operating mine under the operating and environmental conditions in which the dragline
was used.

The deviations of sample cumulative frequencies of the cycle components from their theoretical values (chosen distribution) when tested by stabilized probability plot method, showed that the simple Weibull or simple Lognormal distributions were equally applicable. These distribution were fitted to the various time elements of the dragline work cycle.

COLLECTION OF DATA

This section deals with the collection and analysis of time data for subsequent use in the simulation model of dragline operation. Obed Mountain Coal Co. is located in the Alberta Foothills. It contains two principle coal seams of lower tertiary age. There is an average overburden thickness of 20m covering the No. 2 seam. An interburden layer of approximately 12.5 m separates the lower No.1 seam from the upper No.2 seam. The mine uses a PAGE 757 WALKING DRAGLINE to remove overburden and interburden from the coal. The dragline is equipped with a 57.4 cu.m bucket and a 88.7m boom inclined at 0.576 radians (33 degrees) from the horizontal. (see Figure 1.)

In this study the removal of the interburden is evaluated. The material is removed by a simple side casting stripping method. A large amount of rehandle is necessary to create a 81 m bench (excluding a 6 m wide safety bench) in order to expose the underlying coal. The rehandle material is spoil

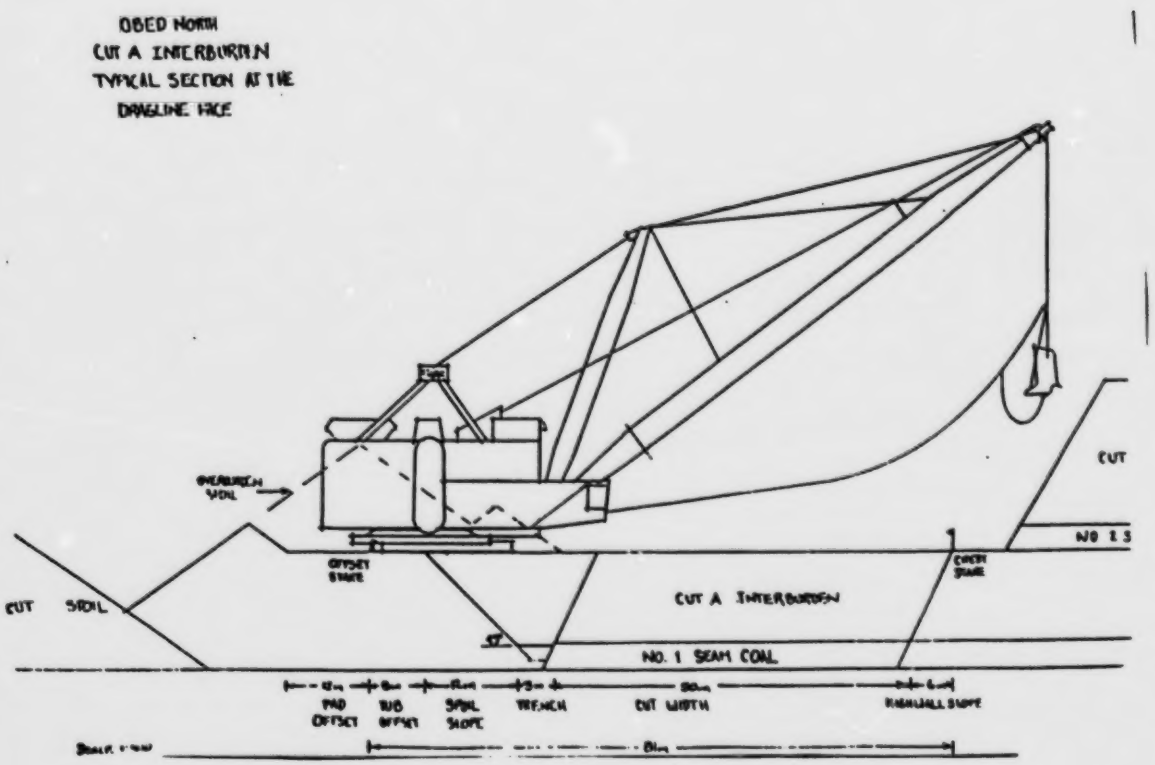

Fig. 1 Section at the Dragline Face

from overburden removal along the same cut. A pit width of 50 m is exposed. During the field study period, dragline cycle times were recorded using a stop-watch by a person stationed inside the dragline cabin. Only day shift operation was monitored.

Four basic measurements were recorded for each cycle:
- drag time,
- swing time,
- dump time,
- swing and reposition time.

In addition to this basic time measurements the number of buckets and total time of walking per shift were recorded as simulation model control variables. The field data in the final computer print out are in the Appendix A.

STATISTICAL ANALYSIS OF COLLECTED DATA

The collected cycle data was tested by comparing the cumulative frequencies of sample data with various theoretical models. By plotting theoretical cumulative frequency versus observed frequency, one measured the departures from the 45° line on the plot as relative goodness of fit with respect to a particular distribution model. When the particular arcsine scaling of the stabilized probability plot procedure is used the sample variance across the distributions are equalized and several distributional models can be visually and objectively compared for goodness of fit. The sample data was also fitted to a distributional model by plotting the model against a histogram made from collected data frequencies. The results showed that the Lognormal or simple Weibull were good candidates.

Figures 2 and 3 show the validity of the chosen distributions using the stabilized probability plot

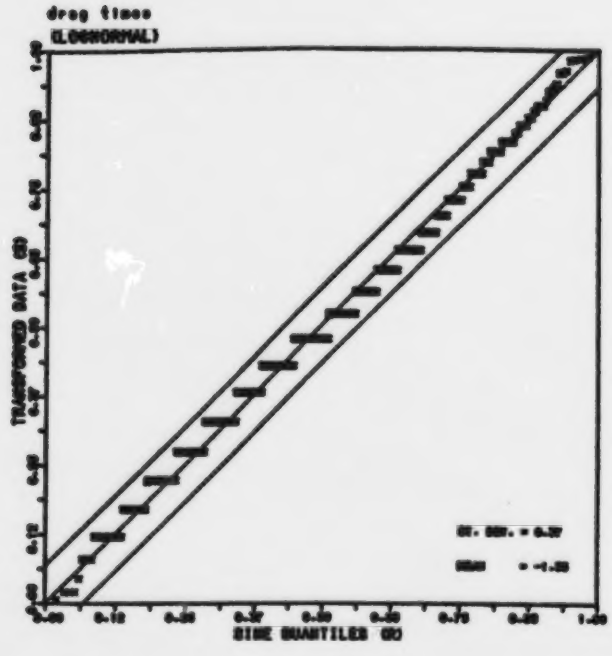

Fig. 2 - Stabilized Probability Plot of 509 Dragline Swing Times on a Lognormal Model.

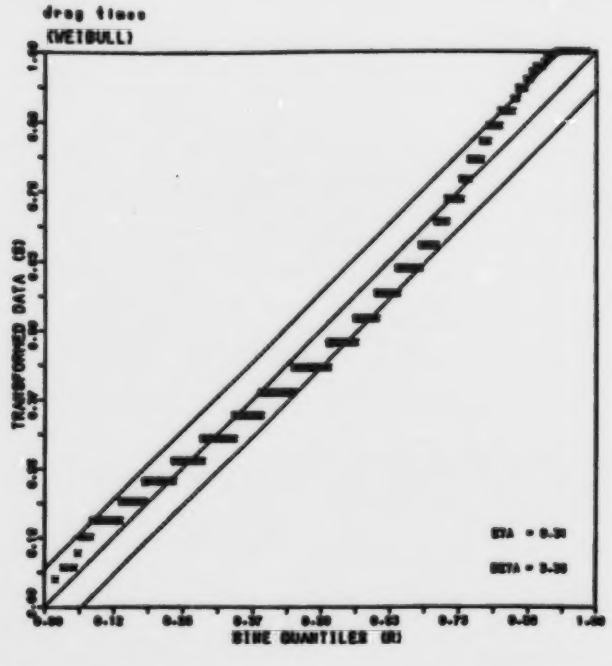

Fig. 3 - Stabilized Probability Plot of 509 Dragline Swing Times on a Weibull Model

A Lognormal cumulative distribution function (c.d.f.) may be defined mathematically as follows.

$$F(t) = \begin{cases} 1/t*\sigma*sqr(2\pi))\ e-(ln(t)-\mu)2/(2\sigma)2, & t>0 \\ 0, & t<0 \end{cases}$$

Where:

F(t)	-	fraction of times less than a given value,
t	-	cycle times,
μ	-	$1/n\ \Sigma\ \ln t_i$,
σ	-	$\Sigma\ (\ln t_i - \mu)^2/n$,
e	-	exponential

The parameters MU (μ) and sigma (σ) are related to the mean and the variance by the following relationship:

$$\text{mean} = e^{(\mu + \sigma^{2/2})}$$

$$\text{variance} = \frac{(e^{\sigma^2} - 1)}{e^{2\mu + \sigma^2}}$$

Estimation of the Lognormal distributions parameters from the time study data was done using the Newton-Raphson iteration technique. This technique uses maximum likelihood estimates to find the parameters. Table 1 shows the estimated Lognormal distribution parameters for all cycle components. The plots of dragline cycle probability density functions of Lognormal distributions are shown in Figures 4-7.

Table 1 Estimates of Parameters of Dragline Cycle Times from Lognormal Distributions

CYCLE TIME COMPONENTS	DISTRIBUTION PARAMETERS		MEAN	STD.DEV
	SIGMA	MU	(MIN)	(MIN)
DRAG	0.3660	-1.3517	0.2767	0.1048
SWING	0.2727	-1.0812	0.3520	0.0978
DUMP	0.3533	-2.1049	0.1297	0.0473
SWING & REPOS	0.3080	-0.8489	0.4487	0.1415

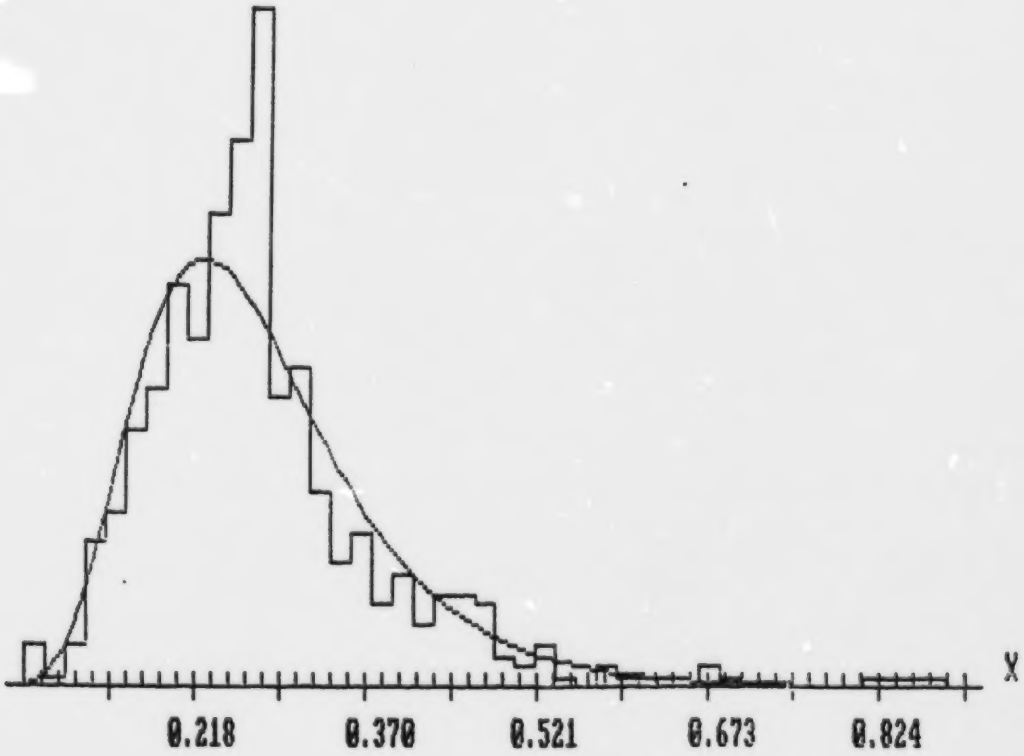

Fig. 4 Lognormal p.d.f. of dragline drag times.

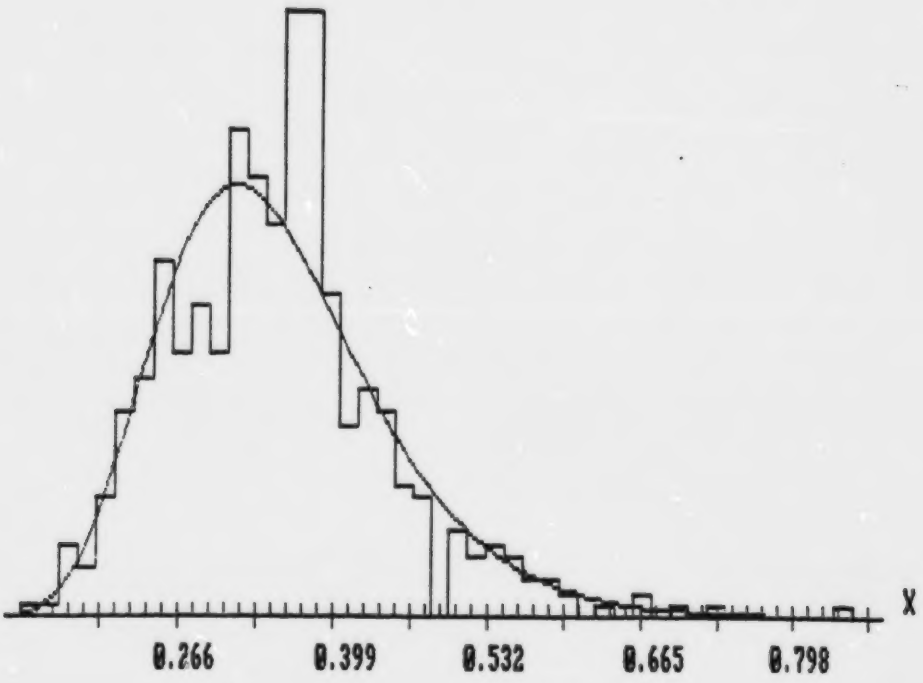

Fig. 5 Lognormal p.d.f. of dragline swing times

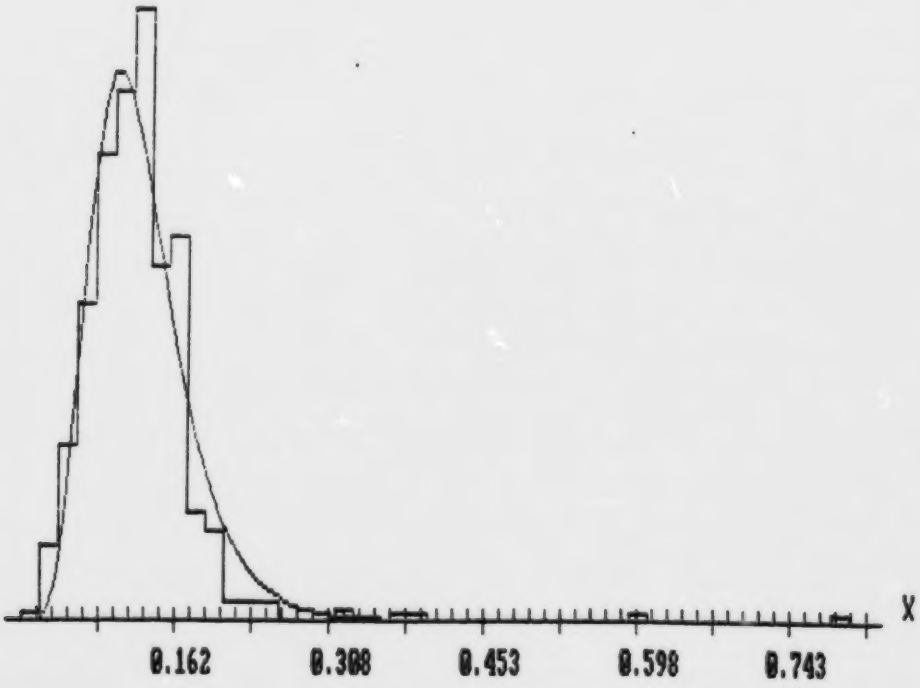

Fig. 6 Lognormal of dragline dump times

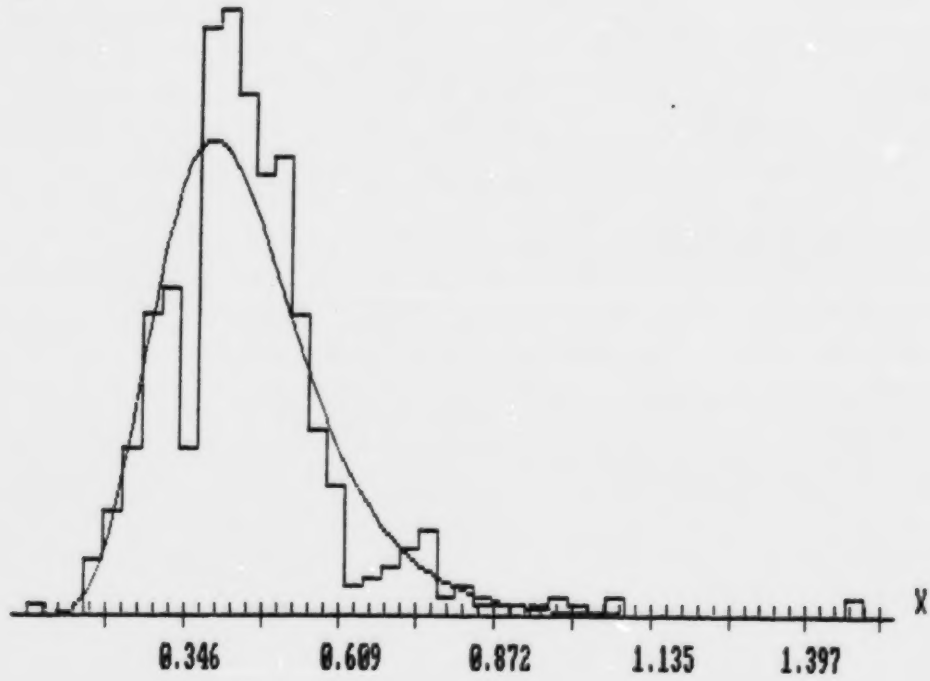

Fig. 7 Lognormal p.d.f. of dragline swing and reposition times

A simple Weibull cumulative distribution function (c.d.f.) may be defined mathematically as follows:

$$F(t) = \begin{cases} 1 - e^{-(t/\eta)^{\beta}}, & t>0 \\ 0, & t<0 \end{cases}$$

Where:

- $F(t)$ - probability of a value less than or equal to t occurring,
- t - cycle times,
- η - characteristic life or scale parameter,
- β - slope or shape parameter, and
- e - exponential.

The parameters eta (η), beta (β), are related to the mean and variance by the following relationship:

$$\text{mean} = \eta\Gamma(1 + 1/\beta)$$
$$\text{variance} = \eta^2[\Gamma(1 + 2/\beta) - \Gamma^2(1 + 1/\beta)]$$

where $\Gamma(\ )$ stands for the gamma function.

Estimations of the Weibull distributions parameters from the time study data was done using an in-house developed program. The program estimates the parameters of a Weibull distribution by the rank regression and maximum likelihood technique. The results showed that the Weibull parameters found using rank regression fit the data better than those parameters found using maximum likelihood. Table 2 shows the estimated Weibull distribution parameters for all dragline cycle components. The plots of dragline cycle probability density functions of Weibull distributions are shown in Figs. 8 - 11.

Table 2 Estimates of Parameters of Dragline Cycle Times from Weibull Distributions

CYCLE TIME COMPONENTS	DISTRIBUTION PARAMETERS		MEAN	STD.DEV
	BETA	ETA	(MIN)	(MIN)
DRAG	3.6024	0.3036	0.2736	0.0844
SWING	4.7535	0.3828	0.3505	0.0841
DUMP	3.7579	0.1420	0.1283	0.0381
SWING & REPOS	3.8273	0.4868	0.4401	0.1285

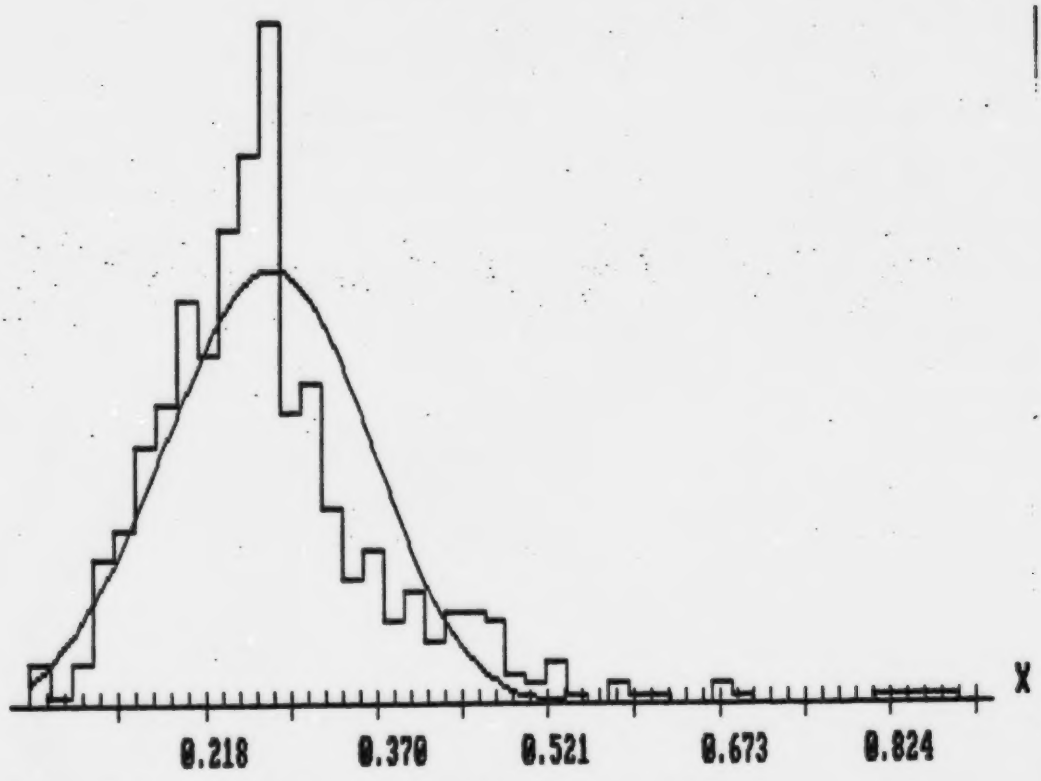

Fig. 8 Weibull p.d.f. of dragline drag times

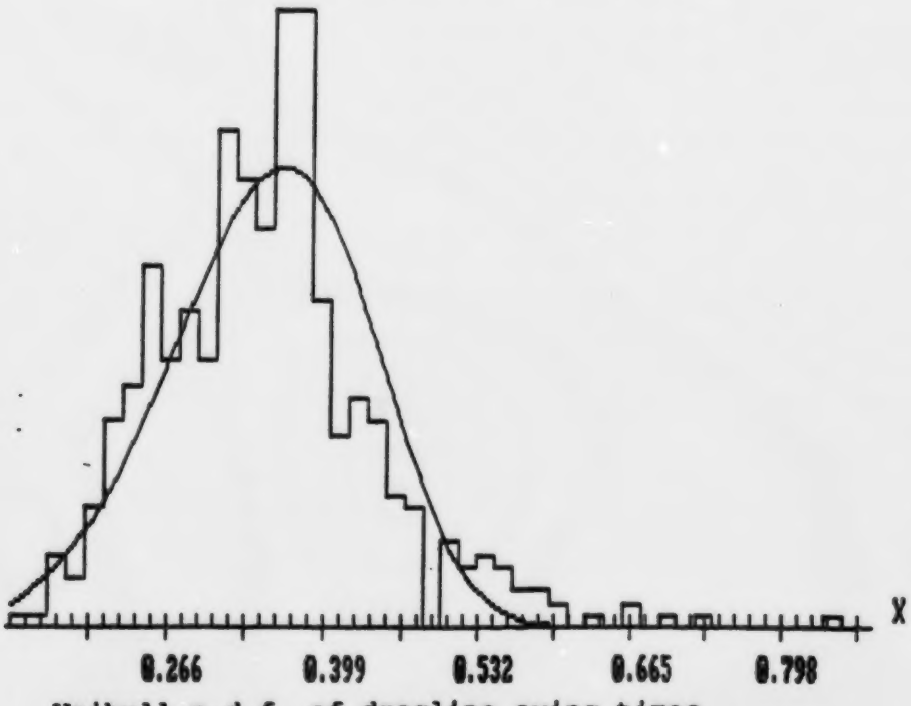

Fig. 9 Weibull p.d.f. of dragline swing times

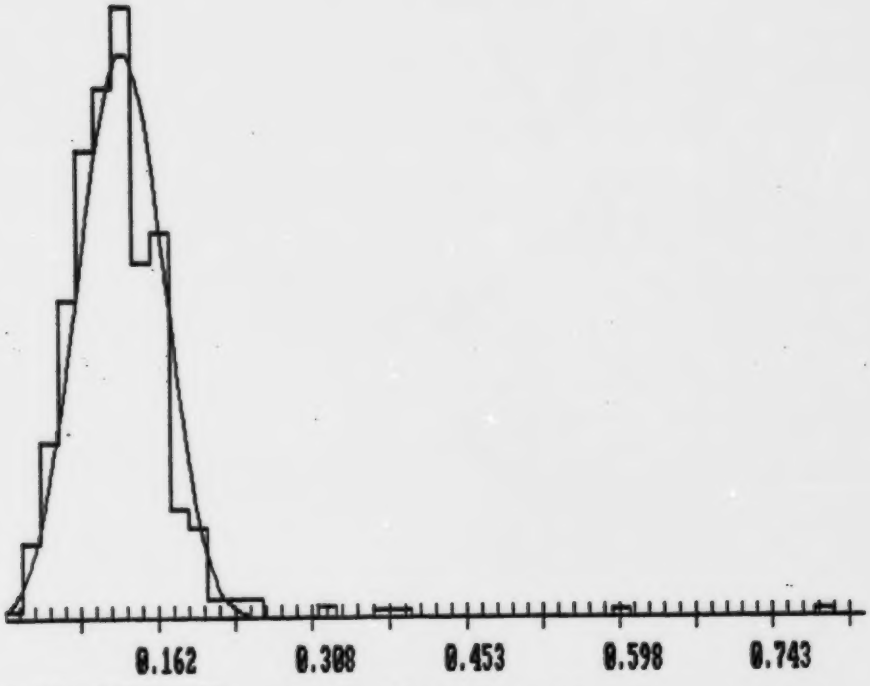

Fig. 10 Weibull p.d.f. of dragline dump times

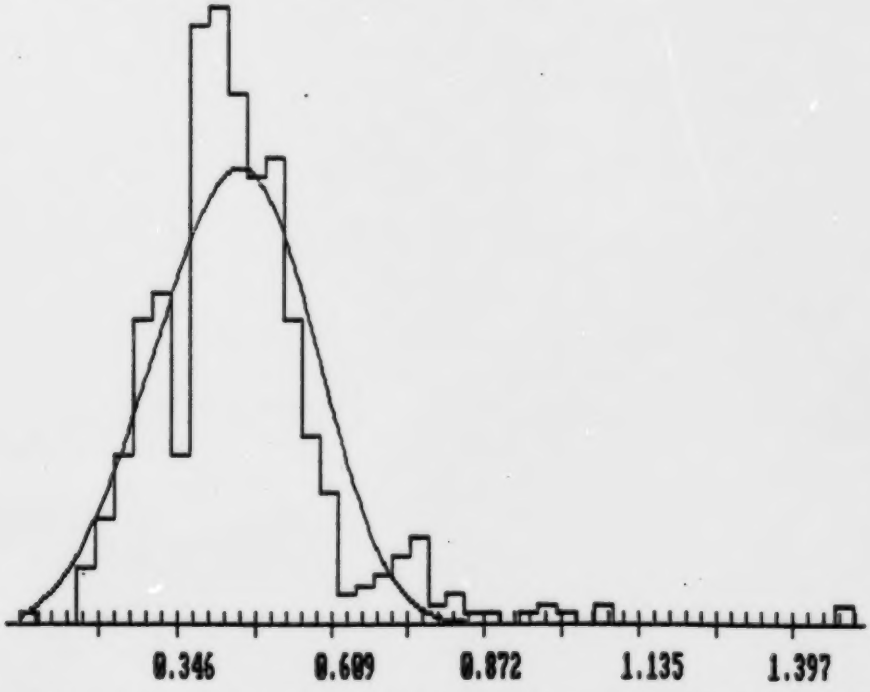

Fig. 11 Weibull p.d.f. of dragline swing and reposition times

CONCLUSIONS

A common problem in computer simulation of stochastic systems is the selection of appropriate statistical distributions for generating random observations.

The collected dragline cycle data were tested by comparing the cumulative frequencies of sample data with various theoretical models. The stabilized probability plot method in the study showed that the simple Weibull or simple Lognormal distributions were equally good candidates.

These distributions were then used in the simulation model to generate its input data.

REFERENCES

1. Michael, J.R., "The Stabilized Probability Plot", Biometrika, 70.1, pp. 11-17, 1983.

APPENDIX "A"
DRAGLINE TIME CYCLE
RAW DATA

RAW DATA USED IN SLAM II DRAGLINE SIMULATION

DRAG TIMES (SECONDS)	SWING TIMES (SECONDS)	DUMP TIMES (SECONDS)	REPOSITION TI (SECONDS)
16.980	18.000	7.020	13.980
18.000	16.020	7.020	16.020
19.020	36.000	12.000	45.000
15.000	15.000	15.000	24.000
13.020	19.020	10.020	25.020
13.980	16.020	7.020	21.000
18.000	22.980	9.000	18.000
22.020	19.980	10.020	24.000
25.980	19.980	10.020	39.000
22.020	18.000	10.980	43.020
31.980	22.020	10.980	43.980
12.000	19.020	10.980	46.020
22.020	22.980	7.980	42.000
25.980	22.020	10.020	54.000
24.000	22.980	7.020	43.980
16.020	22.020	7.020	37.020
22.980	19.020	9.000	31.020
13.980	22.980	6.000	27.000
16.020	21.000	7.980	27.000
25.980	19.020	10.020	34.020
16.020	19.020	10.020	39.000
19.020	18.000	9.000	30.000
16.980	19.020	7.980	30.000
12.000	18.000	7.020	34.980
16.020	16.980	10.020	36.000
16.980	16.980	12.000	34.980
10.980	16.980	9.000	25.980
19.020	19.980	6.000	24.000
9.000	15.000	10.020	22.980
7.980	37.980	7.020	22.980
13.980	19.020	10.020	1.020
18.000	19.980	9.000	24.000
25.980	27.000	7.980	27.000
15.000	22.980	4.980	22.980
16.020	15.000	7.020	37.020
15.000	25.020	4.020	28.020
19.020	28.980	7.020	33.000
15.000	22.980	7.020	31.020
13.980	18.000	9.000	28.020
16.980	22.980	6.000	28.980
22.020	22.020	6.000	22.980
28.980	22.020	7.020	30.000
31.020	22.020	7.020	36.000
36.000	22.020	6.000	27.000
12.000	22.980	6.000	18.000
28.980	24.000	7.980	30.000
19.020	16.980	4.980	25.020
51.000	19.980	7.020	27.000
9.000	19.980	7.980	30.000

27.000	22.020	9.000	30.000
4.980	19.020	9.000	31.980
19.980	19.020	6.000	33.000
12.000	22.020	7.980	37.020
18.000	31.020	4.980	34.980
7.980	25.020	6.000	34.980
27.000	10.980	13.020	31.980
18.000	22.980	7.980	37.980
16.020	24.000	6.000	31.980
19.980	21.000	6.000	36.000
10.980	24.000	7.980	33.000
13.020	28.020	9.000	37.020
4.980	16.020	6.000	43.020
12.000	10.980	7.980	16.980
12.000	12.000	7.980	16.980
10.020	13.020	7.020	19.020
16.980	10.020	7.020	28.980
9.000	13.020	6.000	16.020
13.980	13.980	10.020	16.980
16.020	13.980	7.980	16.020
7.980	13.020	4.020	12.000
9.000	10.980	7.980	16.980
10.980	16.020	6.000	16.980
18.000	22.980	9.000	16.980
19.020	22.020	7.980	33.000
13.980	19.980	7.980	40.980
19.980	22.980	13.980	42.000
24.000	22.980	10.020	58.980
24.000	19.980	10.020	45.000
22.980	22.980	9.000	37.980
19.020	21.000	10.020	52.020
25.980	28.020	7.020	49.020
25.020	25.020	13.020	43.020
21.000	22.980	10.020	57.000
13.020	22.980	9.000	34.980
30.000	21.000	9.000	37.020
24.000	31.020	4.980	45.000
22.980	22.980	6.000	43.020
31.020	19.020	9.000	49.980
33.000	24.000	7.980	45.000
34.980	27.000	22.980	45.000
34.980	25.980	6.000	19.020
40.980	25.980	7.980	43.980
49.020	24.000	7.020	31.980
49.980	27.000	9.000	33.000
25.980	25.020	7.020	45.000
52.980	30.000	6.000	31.020
31.980	25.020	7.980	30.000
16.020	34.980	6.000	27.000
16.980	24.000	10.020	30.000
16.980	16.980	6.000	28.020
22.020	9.000	7.020	37.980
37.020	15.000	19.020	13.020
6.000	19.020	4.020	19.980
25.980	15.000	7.020	18.000
19.020	15.000	4.020	31.020
12.000	22.980	4.980	15.000
4.980	19.020	7.020	19.980
24.000	16.980	4.980	24.000
18.000	25.980	10.020	58.020

25.020	16.020	9.000	22.020
7.020	36.000	7.980	4.980
15.000	40.020	7.980	40.980
19.020	34.980	7.980	37.020
16.980	33.000	7.980	49.020
12.000	33.000	7.020	48.000
16.020	34.020	9.000	36.000
13.020	34.020	7.980	33.000
12.000	22.020	7.020	45.000
13.020	43.980	13.980	19.980
16.020	40.020	10.980	37.020
13.980	13.020	9.000	25.980
16.980	25.980	7.980	4.020
12.000	13.020	6.000	19.020
12.000	15.000	10.020	19.020
10.980	13.020	9.000	25.020
15.000	16.020	7.020	22.980
9.000	15.000	10.980	19.980
15.000	13.980	6.000	12.000
12.000	21.000	7.980	22.020
13.980	16.020	7.020	19.980
12.000	42.000	7.980	30.000
10.020	31.980	9.000	42.000
13.980	31.020	10.980	37.020
16.980	31.020	6.000	34.980
15.000	19.020	7.980	19.980
13.020	19.020	6.000	27.000
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16.020	21.000	9.000	22.020
13.980	22.980	7.980	4.020
16.020	22.020	7.020	25.020
19.020	15.780	6.000	25.980
18.000	27.000	7.020	22.020
13.020	19.980	7.980	27.000
24.000	21.000	7.020	25.980
28.980	19.980	4.980	28.020
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15.000	18.000	9.000	25.020

25.020	19.980	7.980	21.000
19.980	22.980	10.020	28.020
25.020	22.980	7.980	24.000
15.000	22.020	10.980	30.000
27.000	25.980	7.980	28.980
15.000	25.980	9.000	25.020
13.980	19.020	7.980	25.020
15.000	21.000	7.980	24.000
16.020	19.980	7.020	27.000
15.000	21.000	7.980	34.980
16.980	22.020	7.980	22.980
22.020	21.000	9.000	25.020
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13.980	19.020	9.000	25.020
15.000	19.020	7.020	27.000
13.980	19.020	10.020	28.020
10.020	22.020	10.020	25.980
10.020	19.980	9.000	25.980
10.980	22.020	7.980	27.000
12.000	22.020	7.980	25.020
13.020	21.120	7.980	25.020
13.020	22.980	9.000	28.020
15.000	21.000	7.980	24.000
13.020	24.000	9.000	25.980
13.980	25.020	7.020	25.020
18.000	22.020	7.980	24.000
22.980	18.000	12.000	40.020
16.020	24.000	10.020	28.980
21.000	21.000	10.020	25.980
7.980	27.000	4.020	25.980
16.020	27.000	7.020	28.380
7.980	27.000	7.020	25.980
16.020	21.000	7.980	22.980
10.020	22.020	10.020	25.020
18.000	25.980	4.980	25.020
12.000	51.000	15.000	25.980
12.000	28.980	9.000	30.000
27.000	13.020	10.020	28.020
12.000	31.980	9.000	25.020
16.980	33.000	6.000	25.020
15.000	25.980	10.020	24.000
27.000	13.980	7.980	25.980
10.980	31.980	10.020	31.020
18.000	28.980	7.020	21.000
16.980	28.020	10.980	28.020
10.020	33.000	7.020	31.020
24.000	25.980	10.980	25.980
10.020	30.000	10.020	28.980
16.020	30.000	7.020	33.000
16.980	31.980	7.020	28.980
21.000	22.980	7.020	22.020
15.000	30.000	12.000	28.020
15.000	25.980	7.020	24.000
18.000	25.020	7.980	31.980
19.020	22.020	4.980	27.000
19.980	22.980	6.000	31.020
18.000	28.020	7.980	25.980
12.000	34.020	7.980	28.020
13.020	28.020	7.020	31.020
19.020	22.980	9.000	31.980

18.000	22.020	9.000	25.020
18.000	22.020	7.020	33.000
16.980	22.020	9.000	22.980
22.980	24.000	7.020	25.980
12.000	19.020	7.980	22.980
15.000	19.980	6.000	22.980
16.980	13.980	10.020	28.020
12.000	19.980	7.020	25.020
13.020	19.020	9.000	25.020
19.020	19.020	10.020	25.020
12.000	22.020	7.980	22.020
13.980	16.980	9.000	25.020
16.980	21.000	7.980	22.020
13.020	21.000	7.980	28.980
13.020	19.980	7.980	33.000
10.020	19.980	7.020	22.020
15.000	19.020	7.980	22.020
13.020	19.980	10.020	25.020
13.020	19.980	7.020	22.020
15.000	19.020	6.000	24.000
10.980	16.980	6.000	24.000
13.980	19.980	7.020	28.020
10.980	19.980	7.980	24.000
15.000	19.020	6.000	24.000
10.980	19.980	7.020	25.020
15.000	15.000	9.000	22.020
13.020	19.980	7.020	24.000
12.000	21.000	13.980	22.020
27.960	19.020	7.980	18.000
18.000	13.980	12.000	21.000
15.000	22.020	7.020	27.000
10.980	19.020	6.000	22.980
13.980	19.980	6.000	28.020
19.020	13.020	6.000	22.980
10.020	19.980	7.020	21.960
13.980	22.020	4.980	22.980
19.980	22.020	6.000	22.980
13.980	19.980	6.000	22.020
24.000	13.020	6.000	22.980
22.020	16.980	7.020	21.000
9.000	21.000	7.020	22.980
7.980	22.980	4.980	22.980
19.020	15.000	4.020	34.020
13.980	16.980	9.000	25.980
15.000	13.980	7.020	22.980
4.020	22.020	6.000	25.980
10.020	22.020	7.020	25.020
7.980	21.000	6.000	22.980
9.000	22.980	4.020	25.980
15.000	15.000	7.020	27.000
10.020	21.000	7.020	27.000
12.000	22.020	4.980	21.000
10.020	22.980	7.020	24.000
12.000	24.000	4.980	21.000
7.980	31.980	4.020	31.020
13.020	22.020	7.020	33.000
12.000	27.000	4.980	46.980
9.960	22.980	6.000	28.980
7.020	28.980	10.020	25.020
12.000	24.000	6.000	28.020

7.020	22.980	10.980	22.020
10.980	22.980	7.980	25.980
12.000	21.000	7.020	30.000
12.000	22.980	10.020	34.980
13.980	19.020	10.980	34.980
10.980	22.020	12.000	31.020
13.980	24.000	10.020	27.000
10.020	22.020	36.000	28.980
9.000	24.000	9.000	27.000
13.980	22.980	9.000	28.980
10.020	19.980	9.000	25.980
7.980	22.020	10.020	27.000
9.000	22.020	7.980	30.000
13.980	22.020	10.020	28.020
13.980	22.980	10.020	28.020
15.000	22.980	10.020	25.020
10.020	22.020	10.020	25.980
16.020	22.980	10.020	34.980
7.020	22.980	7.980	45.000
13.980	21.000	7.020	28.020
13.980	18.000	7.020	24.000
22.980	18.000	4.980	21.000
9.000	27.000	7.980	22.020
15.000	21.000	6.000	28.980
16.020	30.000	10.980	18.000
22.020	25.980	6.000	27.000
13.020	27.000	4.980	22.020
16.020	27.000	4.980	31.020
19.980	19.980	6.000	31.020
27.000	21.000	3.000	27.000
19.020	18.000	7.980	28.020
21.000	22.980	10.020	34.020
19.020	22.980	7.020	31.020
18.000	19.020	7.980	31.980
22.980	24.000	6.000	22.020
10.980	21.000	4.980	19.020
25.020	16.020	4.980	19.980
22.980	24.000	4.980	27.000
22.020	28.020	4.980	24.000
30.000	16.980	7.980	34.020
28.020	18.000	6.000	34.020
27.000	21.000	7.980	33.000
15.000	33.000	7.020	25.980
12.000	24.000	3.000	34.020
13.020	28.980	7.020	27.000
16.980	28.980	4.980	28.980
19.980	28.980	7.980	22.980
19.980	28.020	6.000	37.020
19.020	27.000	6.000	33.000
19.980	25.020	9.000	28.980
19.020	30.000	3.000	33.000
15.000	24.000	9.000	28.020
10.980	22.980	12.000	28.020
12.000	24.000	9.000	31.020
16.020	22.020	12.000	27.000
10.020	25.020	6.000	28.980
15.000	25.980	7.980	30.000
13.020	27.000	13.020	30.000
16.980	25.980	7.980	34.980
16.020	28.980	7.980	30.000

18.000	24.000	10.020	34.980
15.000	24.000	10.020	28.980
21.000	24.000	7.980	33.000
21.000	22.020	10.020	25.020
10.980	24.000	10.020	27.000
30.000	31.980	6.000	18.000
10.020	21.000	9.000	36.000
16.980	22.020	9.000	31.020
18.000	28.020	7.020	33.000
19.020	25.020	7.980	28.020
16.020	27.000	7.020	25.020
19.020	18.000	7.980	30.000
15.000	27.000	7.020	24.000
16.020	25.980	10.020	25.020
13.980	22.980	9.000	22.980
19.980	34.980	6.000	10.980
7.980	15.000	3.000	16.020
9.000	15.000	1.020	18.000
7.980	10.020	4.020	16.020
10.020	15.000	3.000	13.980
7.980	10.020	4.020	18.000
10.020	13.980	4.980	12.000
9.000	13.020	4.980	16.020
10.980	13.020	3.000	13.980
16.980	16.980	6.000	13.980
13.980	18.000	4.980	13.020
15.000	19.020	4.980	13.020
7.980	12.000	6.000	16.020
16.980	10.020	4.980	15.000
10.020	16.980	6.000	16.020
10.020	19.980	4.980	25.980
9.000	19.020	4.980	21.000
16.980	16.980	4.020	21.000
13.980	16.980	7.020	22.980
19.020	15.000	4.020	22.980
13.020	19.980	4.980	22.020
10.980	21.000	7.980	22.980
15.000	16.980	4.020	22.980
18.000	18.000	6.000	19.980
10.980	16.980	6.000	15.000
10.020	16.020	4.980	25.020
15.000	27.000	7.980	33.000
22.020	22.980	9.000	34.020
22.020	22.980	9.000	31.980
19.980	25.020	12.000	33.000
19.020	24.000	10.020	33.000
22.020	22.980	10.020	31.980
25.980	25.980	10.020	28.980
28.980	25.980	10.020	27.000
42.000	25.020	10.020	31.020
27.000	22.020	9.000	30.000
40.980	25.980	4.980	39.000
16.980	22.980	10.980	30.000
27.000	22.020	10.980	31.020
19.980	19.980	10.980	31.020
18.000	22.020	7.980	28.020
22.020	24.000	9.000	24.000
15.000	15.000	7.980	18.000
15.000	13.980	7.020	21.000
13.020	15.000	7.980	19.980

24.000	19.020	7.980	21.000
16.020	16.020	7.980	18.000
19.020	13.980	7.980	31.020
16.020	22.020	7.020	18.000
19.020	16.020	6.000	21.000
18.000	13.980	6.000	16.980
15.000	15.000	9.000	19.020
19.980	16.020	7.980	18.000
25.020	13.980	6.000	16.980
21.000	12.000	4.020	16.980
22.020	15.000	6.000	18.000
21.000	16.980	6.000	16.980
24.000	13.980	6.000	16.980
19.980	13.980	4.980	16.020
13.980	13.980	4.980	19.020
21.000	16.020	4.980	19.980
16.020	22.020	4.980	19.020
15.000	18.000	4.980	22.020
16.020	16.020	12.000	28.020
19.020	25.020	4.020	30.000
16.020	25.980	4.020	33.000
13.980	25.980	4.020	30.000
13.020	28.020	3.000	30.000
15.000	30.000	4.020	28.980
21.000	28.020	4.020	31.020
15.000	28.980	6.000	31.020
13.980	7.980	4.980	22.020
10.020	19.980	6.000	31.020
16.020	24.000	4.980	28.980
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10.980	22.980	9.000	27.000
12.000	28.020	4.020	30.000
16.020	22.020	3.000	22.980
10.980	22.020	7.980	25.020
13.980	18.000	10.020	22.980
16.980	18.000	10.020	24.000
13.020	22.980	7.980	25.980
21.000	21.000	4.020	25.980
16.020	19.020	10.020	30.000
13.980	21.000	10.020	31.980
19.980	19.980	12.000	33.000
15.000	19.020	10.980	28.020
13.020	22.980	10.980	28.980
10.980	16.020	7.020	31.020
13.020	13.980	7.020	24.000
25.980	15.000	4.980	22.980
15.960	15.000	7.980	18.000
12.000	12.000	7.020	19.020
16.020	13.020	6.000	22.980
12.000	13.980	7.020	22.980
13.980	15.000	6.000	19.980
22.020	16.020	7.020	19.980
15.000	13.980	15.000	27.000
13.980	19.020	7.020	21.000
9.000	19.020	7.980	25.980
13.020	12.000	4.980	16.020
15.000	10.980	6.000	19.020
10.980	16.020	12.000	22.020

13.020	12.000	7.980	16.980
18.000	15.000	6.000	19.020
19.020	19.020	4.020	25.020
19.980	10.020	4.020	16.980
10.980	19.020	4.980	13.980
12.000	22.020	3.000	19.980
18.000	16.020	7.980	16.020
13.020	13.020	7.020	16.980
9.000	15.000	7.020	12.000
10.980	13.020	6.000	16.020
13.020	13.020	4.980	15.000
13.020	12.000	6.000	13.980
13.980	19.980	7.020	13.980
18.000	13.020	4.020	21.000
18.000	13.980	6.000	19.020
10.980	15.000	3.000	16.980
9.000	12.000	3.000	19.020
7.980	13.980	4.980	18.000
10.980	15.960	4.020	16.980
13.980	13.020	4.020	19.980
13.980	12.000	6.000	10.980
24.000	12.000	4.980	15.000
15.000	18.000	4.980	16.980
18.000	15.720	6.000	22.980
19.980	16.020	6.000	22.020
18.000	19.020	4.980	19.020
15.000	16.980	7.980	19.020
13.020	15.000	10.020	19.020
13.980	19.980	3.000	25.020
15.000	16.980	7.980	19.980
16.020	15.000	7.980	19.020
19.020	10.020	10.020	22.980
9.000	15.000	7.980	25.020
19.020	18.000	12.000	13.020
15.000	16.980	7.020	22.020
13.980	22.020	19.020	25.020
12.000	25.020	4.980	30.000
19.980	15.000	12.000	22.980
12.000	22.980	22.020	30.000
15.000	25.020	10.020	24.000